GenFit in sPHENIX: Brief Summary

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GenFit Kalman Filter

- Developed for PandaRoot, and have been used in several experiments: . Belle II, PANDA, SHiP, AFIS, GEM-TPC, FOPI, ...
- Generic Kalman Filter that can handle many types of detector measurements.
- Takes ROOT TGeo geometry.
  - Geometry module that handles GEANT4->TGeo translation by Jin.
- RKTrackRep built in based on GEANT3 track propagation.

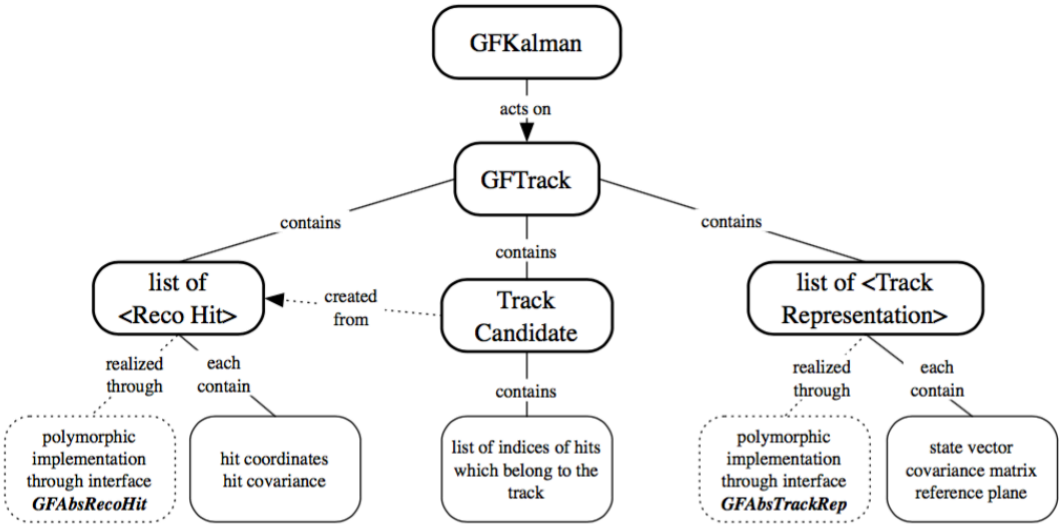


Figure 1.1: General structure of GENFIT.

https://github.com/GenFit/GenFit

GenFit Kalman Filter in sPHENIX

offline/packages/PHGenFit: interface layer that makes it easier to use GenFit.

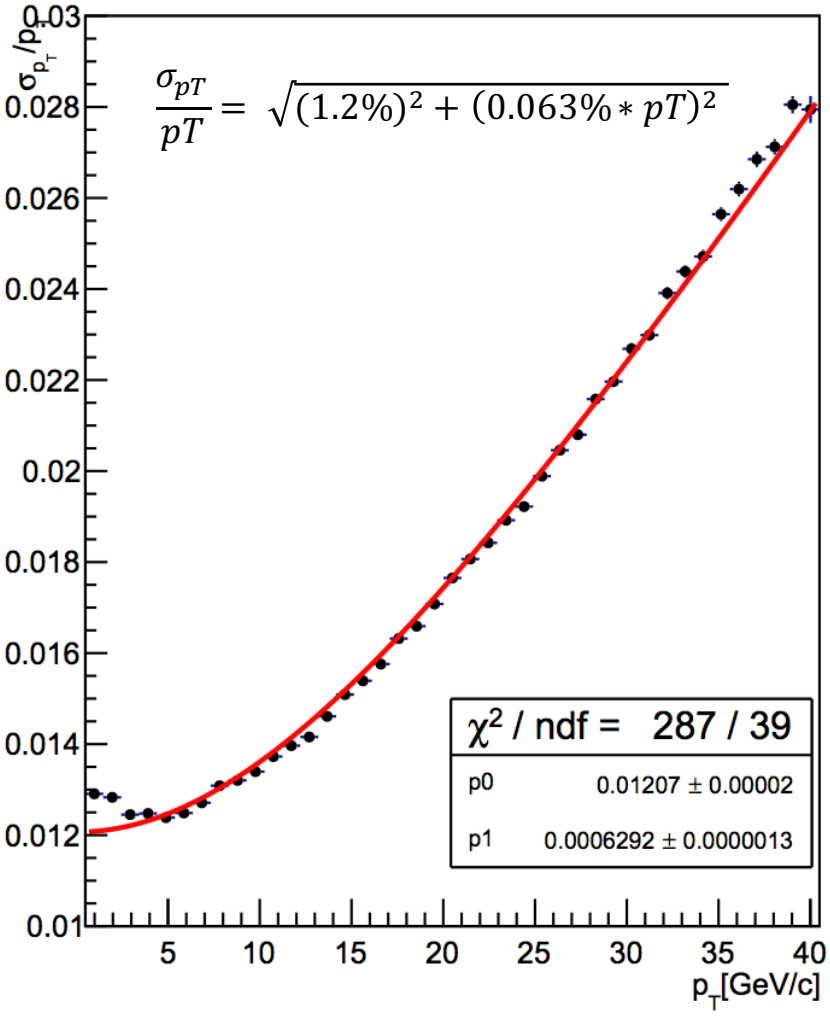
- Fitter:
  - algorithms: KalmanFitterRefTrack, DafRef
- Track:
  - track projection: ToPlane, ToPoint, ToCylinder
- Measurement:
  - types: PlanarMeasurement, SpacepointMeasurement

g4simulation/g4hough/PHG4TrackKalmanFitter

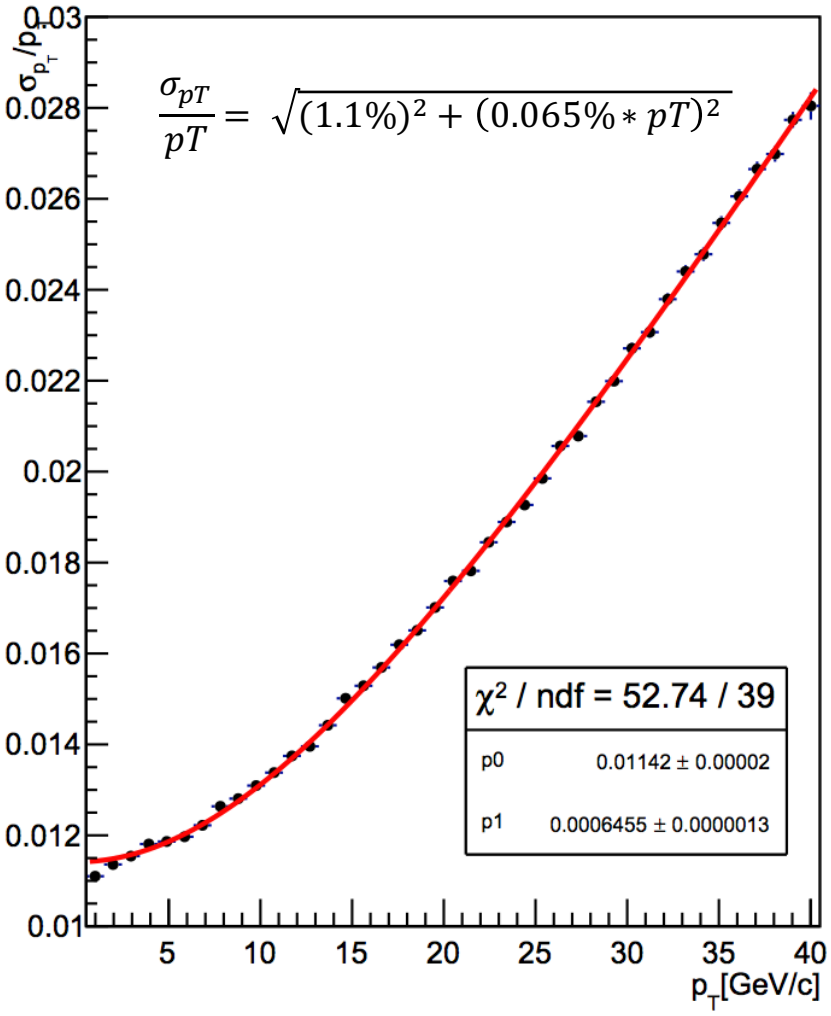
- Fitting tracks with PHGenFit:
  - realistic magnetic field, geometry.
  - outlier rejection: annealing algorithm, working on it.
- Refit track with vertex: primary tracks
- Track projection:
  - fill track states: SvtxTrackStates
  - DCA calculation, working on it
- Interface to RAVE: fill SvtxVertexRefit, work with Sanghoon.

Initial Test: pT resolution, Single Pion, 7-layer silicon tracker

Alan: σ_{p_T}/p_T

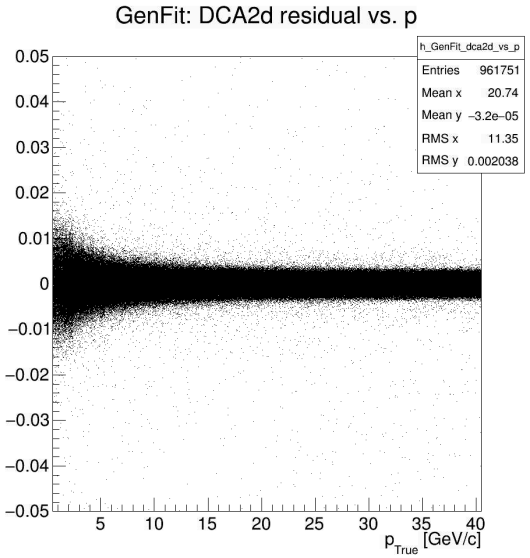


GenFit: σ_{p_T}/p_T

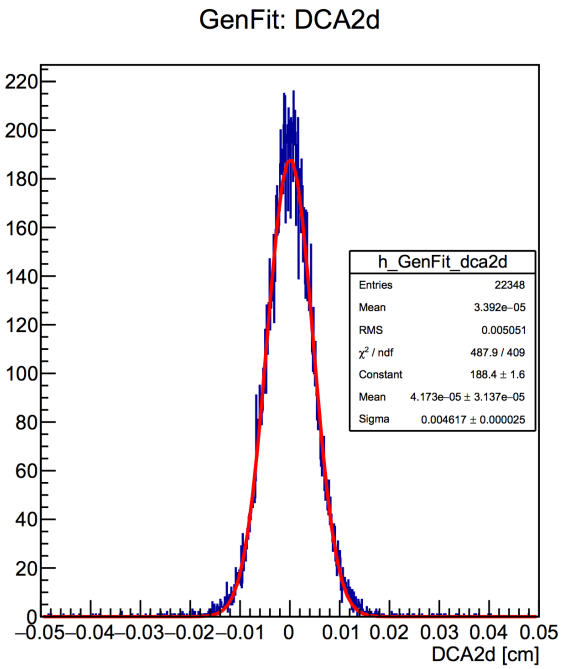


Initial Test: Single Pion Track DCA2d resolution, using true vertex

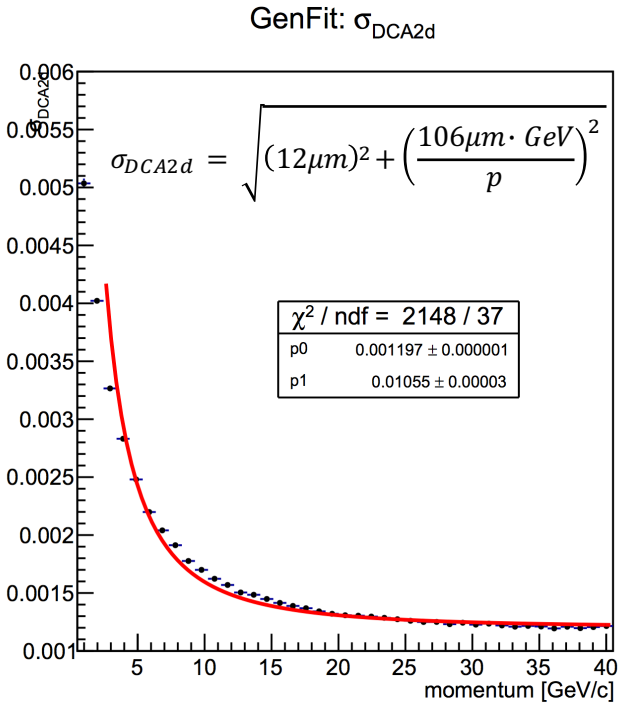
DCA2d residual vs. true momentum (p_True)



DCA2d residual
1 < p_True < 2GeV



DCA2d resolution

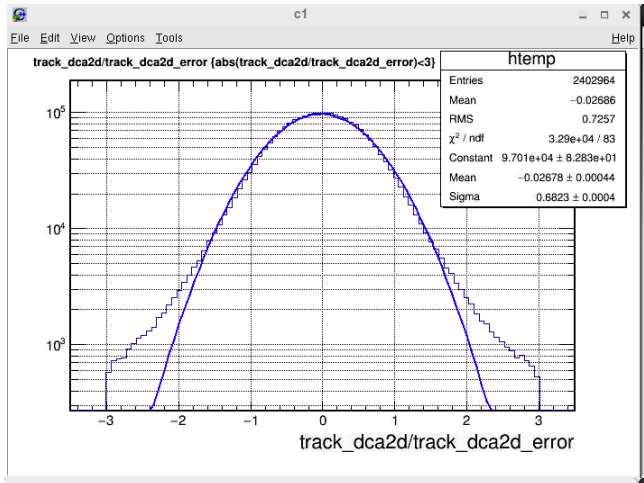


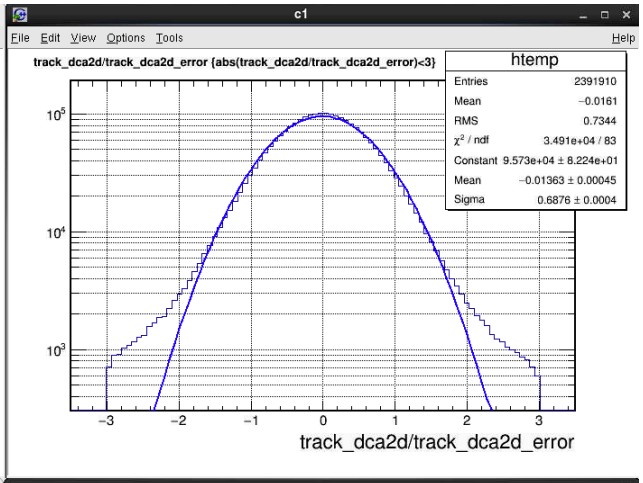
Recent progress: DCA2d error, MAPS+IT+TPC

Origin

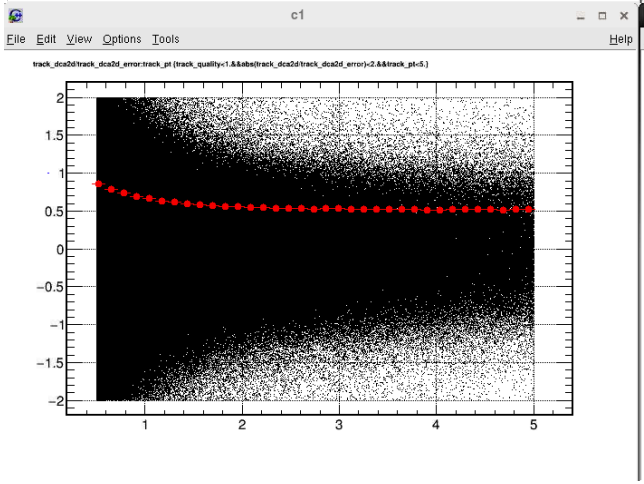
GenFit

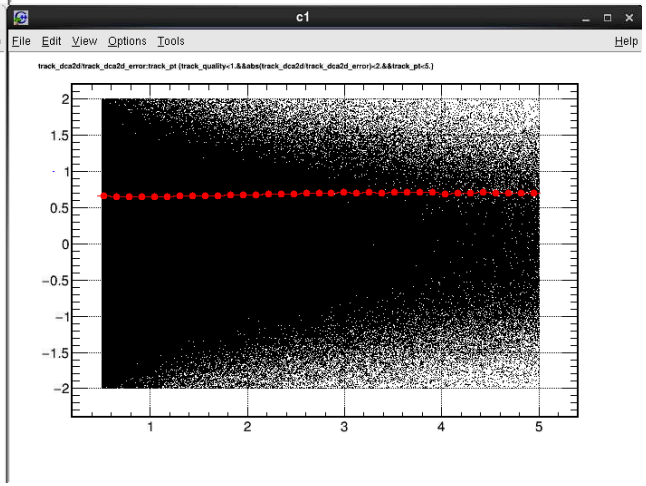
track-by-track dca2d/error





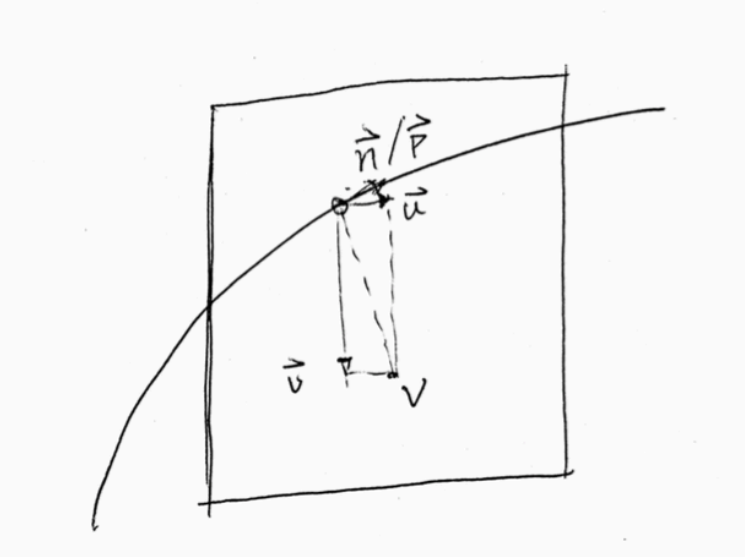
dca2d/error vs. pT





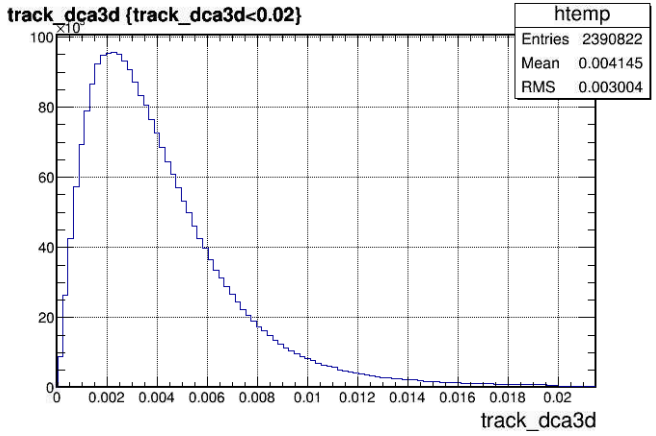
These refit results uses truth vertex(0,0,0) and zero errors for the vertex to isolate the DCA error itself. Same procedure used for the DCA3d plots.

Recent progress: DCA3d

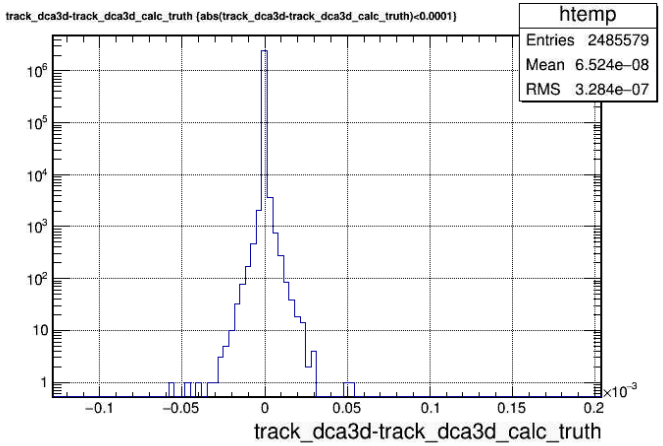


- GenFit can propagate a track to POCA (point of closest approach) of a designated point.
- The states at POCA is defined on a plane that go through the designated point, and perpendicular to the track momentum.
- A GenFit state is (1/p, u', v', u, v).
- dca3d := sqrt(u^2+v^2)
- dca3d_error := sqrt(cov(u,u) + cov(v,v)) → correlation between u and v ignored.

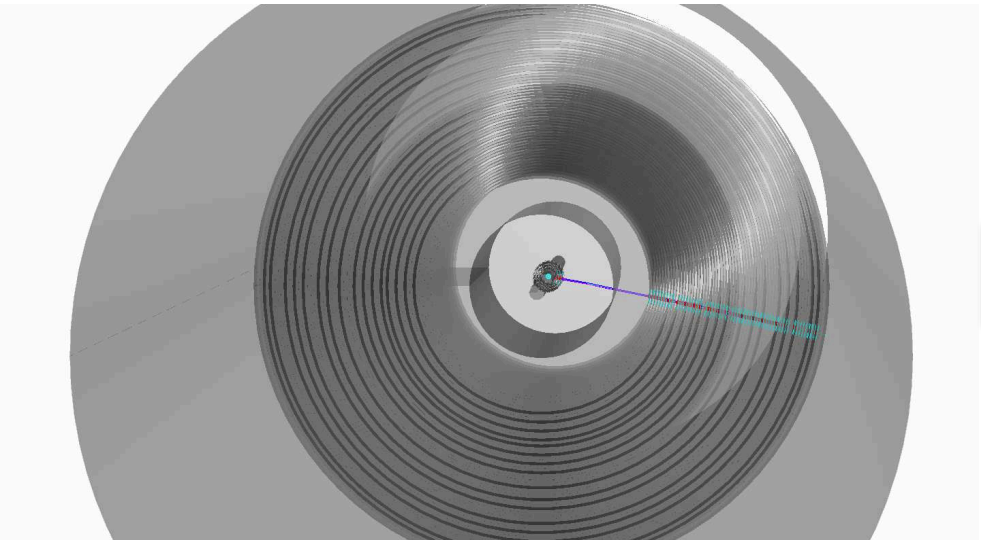
dca3d



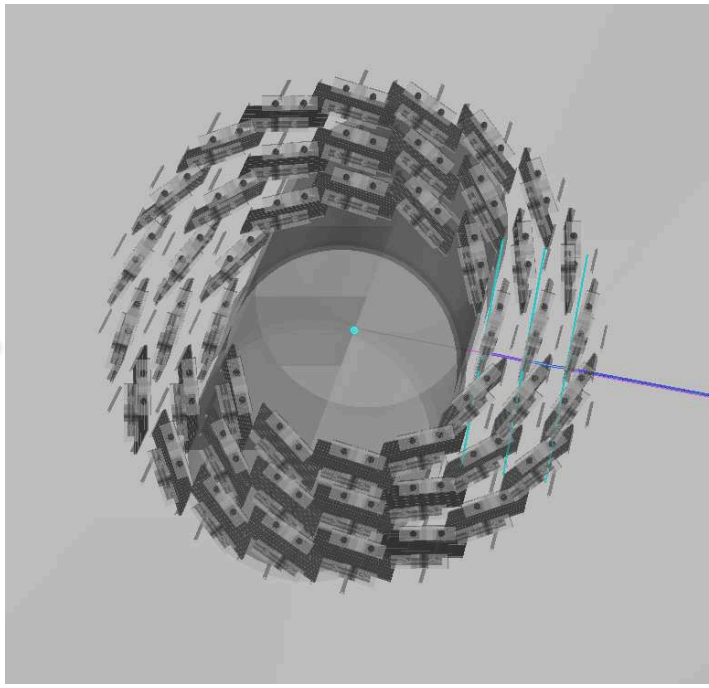
dca3d compared with strait line calculation



Recent progress: Testing on Tony's MAPS ladder geometry



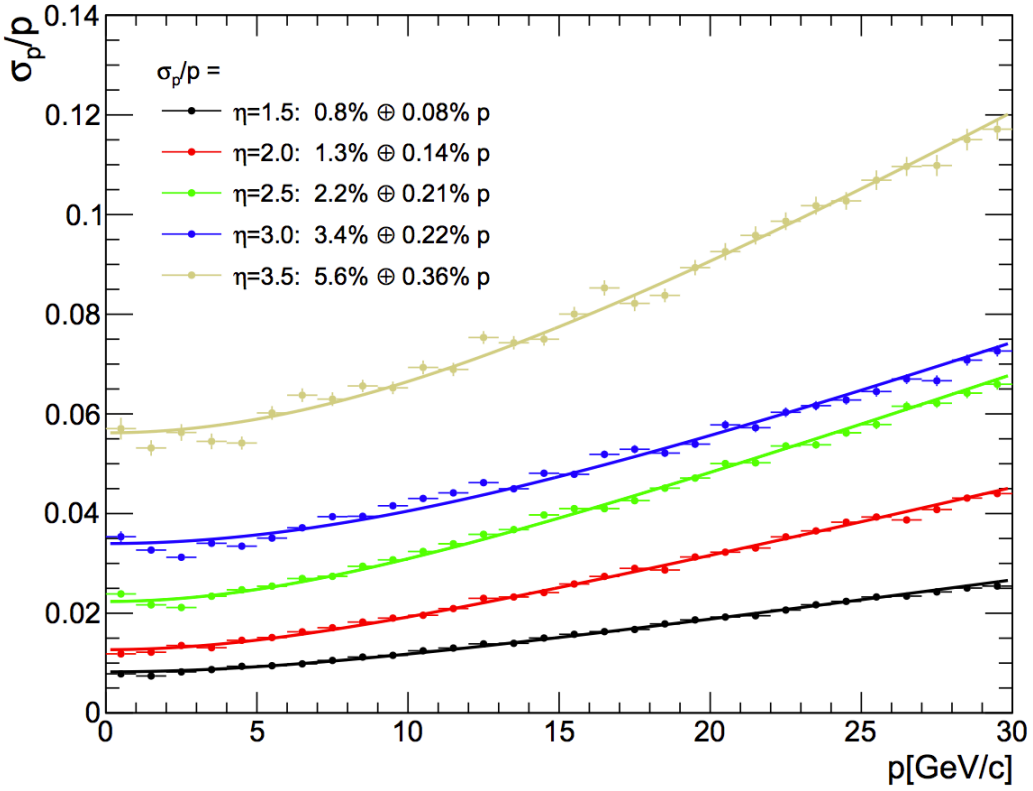
Zoom in



Truth Tracking also using PHGenFit

g4simulation/g4hough/PHG4TrackFastSim

- Truth tracking based on smeared PHG4Hits.
- Can handle cylindrical or vertical plane measurements.



Outlook

- DCA3d development
- Outlier rejection
- Test on ladder geometry
- Reform this GenFit Kalman Filter to fit it into new tracking framework.

Backups